

WHAT IS CLAIMED IS:

1. A braking control device comprising:

a forward object detecting section configured to detect an object in front of a vehicle in which the braking control device is installed;

5 an avoidance possibility determining section configured to determine if the object detected in the front of the vehicle by the forward object detecting section can be avoided by at least one of steering and braking;

an automatic braking section configured to execute automatic braking when the avoidance possibility determining section determines that the object cannot be avoided by  
10 at least one of steering and braking; and

a vehicle behavior response characteristic determining section configured to determine a vehicle behavior response characteristic that includes at least one of a suspension characteristic of the vehicle based on a suspension characteristic setting, a steering avoidance direction force that will be generated in the steering avoidance  
15 direction should the object detected in the front of the vehicle by the forward object detecting section be avoided by steering, a change in a vehicle condition that results in deceleration of the vehicle, and a vehicle-object relationship between a traveling speed of the vehicle and a distance the object and the vehicle that is corrected using a non-linear traveling speed based correction coefficient,

20 the avoidance possibility determining section being further configured to set a method by which the object that is determined to be in the front of the vehicle can be avoided by at least one of steering and braking based on the vehicle behavior response characteristic determined by the vehicle behavior response characteristic determining section.

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2. The braking control device recited in claim 1, wherein

the avoidance possibility determining section includes a steering avoidance determining section configured to determine if the object detected in the front of the vehicle by the forward object detecting section can be avoided by steering.

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3. The braking control device recited in claim 2, further comprising  
a suspension characteristic setting section being configured to change the  
suspension characteristic setting of the vehicle, and  
the steering avoidance determining section further being configured to set the  
5 method by which the object that is determined to be in the front of the vehicle can be  
avoided by steering based on the suspension characteristic setting set by the suspension  
characteristic setting section.

10 4. The braking control device recited in claim 2, further comprising  
a steering avoidance direction force calculating section being configured to  
calculate the steering avoidance direction force that will be generated in the steering  
avoidance direction should the object detected in the front of the vehicle by the forward  
object detecting section be avoided by steering, and  
the steering avoidance determining section being further configured to set the  
15 method by which the object that is determined to be in the front of the vehicle can be  
avoided by steering based on the steering avoidance direction force calculated by the  
steering avoidance direction force calculating section.

20 5. The braking control device recited in claim 4, wherein  
the steering avoidance direction force calculating section calculates a longitudinal  
force and a load acting on wheels of the vehicle and calculates the steering avoidance  
direction force based on the longitudinal force and the load.

25 6. The braking control device recited in claim 1, wherein  
the avoidance possibility determining section includes a braking avoidance  
determining section configured to determine if the object detected in the front of the  
vehicle by the forward object detecting section can be avoided by braking.

30 7. The braking control device recited in claim 6, further comprising  
a throttle-fully-closed deceleration calculating section being configured to  
calculate an accelerator pedal release deceleration that will result should an accelerator  
pedal be released, and

the braking avoidance determining section being configured to set the method by which the object that is determined to be in the front of the vehicle can be avoided by braking based on the accelerator pedal release deceleration calculated by the throttle-fully-closed deceleration calculating section.

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8. The braking control device recited in claim 2, wherein the avoidance possibility determining section includes

10 a steering avoidance threshold value setting section configured to set a variable steering avoidance threshold value for determining if the object detected in front of the vehicle by the forward object detecting section can be avoided by steering based on the vehicle-object relationship between the traveling speed of the vehicle and the distance the object and the vehicle that is corrected using the non-linear traveling speed based correction coefficient,

15 a steering avoidance possibility determining section configured to determine that the object detected in the front of the vehicle by the forward object detecting section cannot be avoided by steering when the vehicle-object relationship between the object and the vehicle matches the variable steering avoidance threshold value set by the steering avoidance threshold setting value setting section,  
20 and

a traveling speed detecting section that detects the traveling speed of the vehicle,

25 the steering avoidance threshold value setting section being configured to set the steering avoidance threshold value for determining if the object in the front of the vehicle can be avoided by steering based on the vehicle traveling speed detected by the traveling speed detecting section.

9. The braking control device recited in claim 8, wherein  
the steering avoidance threshold value setting section adjusts the variable threshold  
value for determining if the object can be avoided by steering based on at least one of a  
time and the distance between the vehicle and the object, and

5 the steering avoidance threshold value setting section further adjusts the variable  
threshold value for determining if the object can be avoided based on the traveling speed  
of the vehicle as detected by the traveling speed detecting section such that a first  
threshold value is set when the traveling speed is within a low speed region, a second  
threshold value is set when the traveling speed is within a medium speed region, and a  
10 third threshold value is set when the traveling speed is within a high speed region, with the  
first threshold value for the low speed region being set larger than the second and third  
threshold values of the medium speed region and the high speed region, respectively, and  
the second threshold value for the medium speed region being set smaller than the first and  
third threshold values of the low speed region and high speed region, respectively.

15 10. The braking control device recited in claim 8, wherein  
the steering avoidance determining section is further configured to adjust the  
variable steering avoidance threshold value based on a suspension characteristic setting set  
by a suspension characteristic setting section.

20 11. The braking control device recited in claim 8, wherein  
the steering avoidance determining section is further configured to adjust the  
variable steering avoidance threshold value based on a steering avoidance direction force  
calculated by a steering avoidance direction force calculating section.

25 12. The braking control device recited in claim 11, wherein  
the steering avoidance determining section is further configured to adjust the  
variable steering avoidance threshold value based on a suspension characteristic setting set  
by a suspension characteristic setting section.

13. The braking control device recited in claim 12, wherein  
the steering avoidance threshold value setting section adjusts the variable threshold  
value for determining if the object can be avoided by steering based on at least one of a  
time and the distance between the vehicle and the object, and

5 the steering avoidance threshold value setting section adjusts the variable threshold  
value for determining if the object can be avoided based on the traveling speed of the  
vehicle as detected by the traveling speed detecting section such that a first threshold value  
is set when the traveling speed is within a low speed region, a second threshold value is set  
when the traveling speed is within a medium speed region, and a third threshold value is  
10 set when the traveling speed is within a high speed region, with the first threshold value  
for the low speed region being set larger than the second and third threshold values of the  
medium speed region and the high speed region, respectively, and the second threshold  
value for the medium speed region being set smaller than the first and third threshold  
values of the low speed region and high speed region, respectively.

15 14. The braking control device recited in claim 8, wherein  
the avoidance possibility determining section includes a braking avoidance  
determining section configured to determine if the object detected in the front of the  
vehicle by the forward object detecting section can be avoided by braking.

20 15. The braking control device recited in claim 14, further comprising  
a throttle-fully-closed deceleration calculating section being configured to  
calculate an accelerator pedal release deceleration that will result should an accelerator  
pedal be released, and

25 the braking avoidance determining section being configured to set the method by  
which the object that is determined to be in the front of the vehicle can be avoided by  
braking based on the accelerator pedal release deceleration calculated by the throttle-fully-  
closed deceleration calculating section.

16. The braking control device recited in claim 2, further comprising the avoidance possibility determining section includes a braking avoidance determining section configured to determine if the object detected in the front of the vehicle by the forward object detecting section can be avoided by braking.

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17. A braking control device comprising:

forward object detecting means for detecting an object in front of a vehicle in which the braking control device is installed;

avoidance possibility determining means for determining if the object detected in the front of the vehicle by the forward object detecting section can be avoided by at least one of steering and braking;

automatic braking means for executing automatic braking when the avoidance possibility determining means determines that the object cannot be avoided by at least one of steering and braking; and

vehicle behavior response characteristic determining means for determining a vehicle behavior response characteristic that includes at least one of a suspension characteristic of the vehicle based on a suspension characteristic setting, a steering avoidance direction force that will be generated in the steering avoidance direction should the object detected in the front of the vehicle by the forward object detecting section be avoided by steering, a change in a vehicle condition that results in deceleration of the vehicle, and a vehicle-object relationship between a traveling speed of the vehicle and a distance the object and the vehicle that is corrected using a non-linear traveling speed based correction coefficient,

the avoidance possibility determining means being further configured to set a method by which the object that is determined to be in the front of the vehicle can be avoided by at least one of steering and braking based on the vehicle behavior response characteristic determined by the vehicle behavior response characteristic determining section.

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18. A method of controlling vehicle braking comprising:  
detecting an object in front of a vehicle;  
determining if the object detected in the front of the vehicle can be avoided by at  
least one of steering and braking, where an avoidance possibility determination is made

5 based on

determining a vehicle behavior response characteristic that includes at  
least one of a suspension characteristic of the vehicle based on a  
suspension characteristic setting, a steering avoidance direction  
force that will be generated in the steering avoidance direction  
should the object detected in the front of the vehicle by the  
forward object detecting section be avoided by steering, a change  
in a vehicle condition that results in deceleration of the vehicle,  
and a vehicle-object relationship between a traveling speed of the  
vehicle and a distance the object and the vehicle that is corrected  
using a non-linear traveling speed based correction coefficient,  
and;

executing automatic braking upon determining that the object cannot be avoided by  
at least one of steering and braking.

19. The method recited in claim 18, wherein  
the avoidance possibility determination is performed by  
detecting the vehicle traveling speed,  
setting a variable steering avoidance threshold value for determining if  
the object detected in front of the vehicle by the forward object  
detected in front of the vehicle can be avoided by steering based  
on the vehicle-object relationship between the traveling speed of  
the vehicle and the distance the object and the vehicle that is  
corrected using the non-linear traveling speed based correction  
coefficient, and  
determining that the object detected in the front of the vehicle by the  
forward object detecting section cannot be avoided by steering  
when the vehicle-object relationship between the object and the

vehicle matches the variable steering avoidance threshold value based on the vehicle traveling speed detected.

20. The method recited in claim 19, wherein

5 the avoidance possibility determination is further performed by

adjusting the variable threshold value for determining if the object can be avoided by steering based on at least one of a time and the distance between the vehicle and the object, and

10 further adjusting the variable threshold value for determining if the object can be avoided based on the traveling speed of the vehicle such that a first threshold value is set when the traveling speed is within a low speed region, a second threshold value is set when the traveling speed is within a medium speed region, and a third threshold value is set when the traveling speed is within a high speed region, with the first threshold value for the low speed region being set larger than the second and third threshold values of the medium speed region and the high speed region, respectively, and the second threshold value for the medium speed region being set smaller than the first and third threshold values of the low speed region and high speed region, respectively.

21. The method recited in claim 19, wherein

25 further adjusting of the variable steering avoidance threshold value is based on a suspension characteristic setting.

22. The method recited in claim 19, wherein

further adjusting of the variable steering avoidance threshold value is based on a steering avoidance direction force.

30 23. The method recited in claim 22, wherein

further adjusting of the variable steering avoidance threshold value is based on a suspension characteristic setting.



24. The method recited in claim 19, wherein  
the avoidance possibility determination is further performed by determining if the  
object detected in the front of the vehicle by the forward object detecting section can be  
5 avoided by braking.